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LEAD DEPOSITS OF THE USSR

Lead is rarely found as an independent ore, but usually occurs together with zinc, copper, and other metals, to form a polymetallic ore. USSR reserves of lead ore are larger than those of any capitalist country. In the USSR, polymetallic ores are to be found in the following areas:

1. Sikhote-Alin' Rayon (Far East), large Tetyukhe deposit
2. Nerchinsk Rayon (Eastern Transbaykal), large Kadainsk deposit
3. Salair Rayon (Western Siberia), a deposit bearing the same name
4. Altay (Kazakhstan), large Leninogorsk and Zyryanovsk deposits
5. Kara-tau Rayon (Southern Kazakhstan), large Turlan deposit
6. Karamazar (Uzbekistan), a number of polymetallic deposits
7. Sadon Rayon (Northern Osetiya), Sadon and Buron deposits

Additional polymetallic deposits are found in Yakutsk, Transcaucasus, Vaygach Island, and other places.

1. Far Eastern Deposits

The Far Eastern deposits of polymetallic ores are located on the shore of the Sea of Japan, on the eastern slope of the Sikhote-Alin' mountain range. The largest of these is the Tetyukhe deposit.

The form and condition of the occurrence of the ore body are extremely diverse. There are ore seams at the contact of limestone and quartz porphyry; stratified seams and veins at the junction of limestone and tuff with argillaceous shale; stratified cross veins in argillaceous shale; and, finally, the zone of phenocryst and strata of fine irregular streaks in quartzites and siliceous shale.

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Pyritic ores consist of galenite, zinc blende, copper pyrite, magnetic pyrite, pyrite, white iron pyrite, arsenopyrite, small amounts of gray copper ore, tennantite, magnetite and, occasionally, tinstone.

The vein mineral consists of manganosiderite, calcite, garnet, quartz, barite, epidote, and others.

The composition of the minerals varies with the depth of occurrence. In the shallower beds of the hypothermal zone the quantity of heavy silicates of copper pyrite and magnetic pyrite is smaller, while the amount of quartz and calcite is larger.

In several sectors of the deposit an outcrop of bismuth is observed. Certain places also contain cadmium.

Many deposits do not contain a zone of oxidation. In the Tetyukhe deposit, pipe-shaped beds of oxidized ore form individual pockets, which lie apart from the main pyritic body.

The oxidized ores consist of smithsonite, hydrozincite, willemite, cerussite, malachite, azurite, pyroluzite, and brown iron ore. Of the larger deposits the following should be mentioned:

a. Tetyukhe deposit, which is the largest explored polymetallic deposit of the Sikhote-Alin ore district. The deposit is located on a high ridge of the left bank of the Borisov ravine and the Tetyukhe River. Pyritic ore consists of zinc blende, lead glance, copper pyrite, magnetic pyrite, pyrite, arsenopyrite, and copper glance. The vein material is made up of thermolite, manganosiderite, calcite, partly also of barite, garnet, and ilvaite.

b. Bolshoy Sinanchin deposit, contains zinc blende, lead glance, and tin.

Of the other deposits of the Primorsk Rayon, the following deserve mention: Kirillovsk, Kisinsk, Gorbushinsk, and Shcherbakovsk. All of the mined ore is sent to the Tetyukhe dressing plant.

As a result of selective flotation, two kinds of concentrates are obtained: lead and zinc. Lead concentrates are processed locally at the lead smelting plant. Zinc concentrates, pending the construction of a plant in the local mining area, are shipped to the existing zinc plants.

2. Eastern Transbaykal Deposits

The majority of the Eastern Transbaykal (Nerchinsk Rayon) deposits are located in the territory between the Shilka and Argun'ya rivers and the Transbaykal railroad.

Almost all deposits of the Eastern Transbaykal occur in limestone and dolomite.

Nerchinsk ores are divided into oxidized and primary ores. The zone of carbonization is shallow.

The Nerchinsk deposits are characterized by a large variety of metals. They contain lead, zinc, copper, silver, arsenic, gold, tin, antimony, wolfram, and several other elements; hence, the unusually complex mineralogical composition of these ores. The oxidized zone includes the following minerals: limonite, cerussite, smithsonite, mimetesite, and scorodite. Nonore elements are represented by various carbonates and quartz. Primary ores consist of minerals such

as pyrite, arsenopyrite, zinc blende, galenite, boulangerite, and pyrrhotine. In isolated cases marcasite, cassiterite, and other minerals are encountered. Nonmetallic minerals include calcite, dolomite, manganosiderite, quartz, sericite, and turmaline. The ores belong to the ingrained type; massive ores are rare.

The Nerchinsk region is considered to have large potential reserves of lead, zinc, silver, arsenic, and other metals.

3. Salair Deposits

The Salair deposits of polymetallic ores are found in the northeastern slope of the Salair mountain range, in West Siberia. They contain less metal than the genetically related Altay deposits.

The ore is located along the longer axes of the ellipse of the deposit. A large number of the deposits have the form of irregular lenticular bodies. Deposits in the oxidized zone represent ocherous barites with significant contents of silver and gold.

The composition of the rock in the Salair deposits is rather even. In the upper horizon the ore consists of quartz-barite, or just barite. In the lower horizon the ore is barite and quartz or barite and quartz carbonate.

Sulfides are present in the form of minute impregnations and are usually distributed evenly throughout the ore mass. On rare occasions sulfides are concentrated in the form of bands.

The following mineral ores are to be found in the Salair deposits: sphalerite, pyrite, galenite, tetrahedrite, copper pyrite, tennantite, covellite, chalcosine, silver glance, cerussite, native silver, and gold. Quartz and barite make up the gangue.

Ore extracted in the Salair mine is processed the the Salair dressing plant. Three kinds of concentrates are obtained in the process of selective flotation: zinc, lead, and barite.

4. Altay Deposits

Altay polymetallic deposits are located in the southwestern spurs and foothills of the Altay Mountains. This is the most important USSR area for the production of lead and zinc.

Besides zinc and lead, Altay ores also contain copper, cadmium, antimony, silver, and gold. In respect to precious metals, Altay deposits occupy an exceptional position. The large amounts of gold and silver in the upper oxidized horizons of individual deposits stimulated the early exploitation of these deposits, which began many years ago.

At present, with the development of methods for the reprocessing of sulfides and poor ores, the Altay deposits occupy one of the first places in the USSR.

Ore deposits occur here amid limestone and tuff, lead and porphyry.

Morphologically the Altay deposits are quite diverse. Complex deposits predominate. Usually, deposits of uninterrupted pyritic ores occur with fairly extensive zones of phenocrysts. The primary pyritic ores of the polymetallic deposits consist of pyrite, sphalerite, galenite, chalcopyrite, and tetrahedrite. Arsenopyrite and pyrrethine occur less frequently.

Gold is found in pyritic ores in native state and frequently in the form of tellurous compound.

Gangue minerals include quartz, barite, and small amounts of carbonates, cericite, and chlorite.

In many deposits there is a marked zonal transformation in the character of the ore, which depends on the depth of the ore's occurrence. The amount of sphalerite and pyrite is increased, and barite takes the place of quartz. Oxidized ores contain gold and silver with small amounts of zinc.

The Altay area may be divided into six fields:

a. Leninogorsk field with the large Leninogorsk and Sokol'nyy deposits and the smaller Kryukovsk, Il'insk, Uspensk, and Filippovsk deposits.

b. Zyryanovsk field with the large Zyryanovsk deposit and a number of smaller deposits, such as Zavodinsk, Bukhtarminsk, and others.

c. Irtysh field with Belousovsk and Berezovsk, Nikolayevsk, Talovsk, and other deposits.

d. Zmeinogorsk field with the large Zmeinogorsk and Petrovsk deposits, and the smaller Semenovsk, Cherepanovsk, and other deposits.

e. Shemanaikhinsk field.

f. Kolyvansk field with a number of small deposits.

At present, the first four of the above-named ore fields have an industrial significance. These four fields have large reserves of polymetallic ores containing precious metals.

Of all the above-mentioned regions the Leninogorsk group has the largest actual and indicated reserves.

5. Kara-tau Deposits

Kara-tau region, in southern Kazakhstan, is an important polymetallic ore region. The ore minerals include galenite, sphalerite, pyrite, and occasionally chalcopyrite, and arsenopyrite. The gangue is made up of calcite, dolomite, siderite, and occasionally there is quartz and barite. The ore of the Kara-tau region is slightly silvery.

On the surface of the deposit the ore is almost always oxidized and not infrequently the zone of oxidation attains great depth. Zinc is sometimes found in a leached state and is deposited beyond the limits of lead ore, forming a secondary accumulation of almost pure oxidized zinc ore with a small lead content.

Oxidized ores are highly ferrous. They are porous, have a yellow or red-brown color and consist of ocherous, sometimes clayey iron ore which contains the oxidized lead and zinc minerals. In the oxidized zone lead minerals are represented chiefly by cerussite, anglesite in insignificant amounts, and plumbodzhorosite [?]. Zinc appears as smithsonite, hydrozincite, mangemite (carbonate of iron and zinc), and also as a peculiarly soft (stearin-like) silicate of aluminum and zinc, containing Al and Zn in varying ratios, isomorphically replacing each other.

Nearly all lead-zinc deposits of the Kara-tau region are located in the Central Kara-tau (Turlan, Kantagi, Mirgalim-say, Kara-say and others). The Baydzhansay and Suleymansay deposits are located separately in Southern Kara-tau.

Of all the Kara-tau deposits the largest and best explored is the Turlan deposit.

6. Karamazar Deposits

Polymetallic ore deposits are located in the southern slope of the Karamazar Mountains (Uzbekistan).

The Karamazar deposits may be divided into two geological groups: those found amid volcanic rocks and those connected with limestone.

Deposits found amid volcanic rocks belong to the hydrothermal type having sulfide polymetallic ores of complex composition. The basic metals of these deposits are lead, silver, zinc and iron, and to a lesser extent, copper. Some ores also contain antimony, arsenic, cadmium, gold and, in exceptional cases, wolfram, molybdenum, and uranium. The upper zones of the deposits contain oxidized ore. Of the individual deposits of this group, Kan-i-Minsur and Tary-Ekan deserve mentioning.

Deposits of the second group, occurring in limestone, consist of rich polymetallic ores which contain chiefly sulfides; lead and zinc, occasionally arsenic, iron, and copper. Kan-say, Takeli, Altyn-Topkan, and Yuzhnaya Darbaza belong to the deposits of the second group.

7. Northern Caucasus Deposits

Lead deposits in the Northern Caucasus are to be found in Sadon (in Northern Osetiya) and Balkarsk, Karachayevsk, Chechensk, Adygeysk and Samursk rayons (Dagestan).

The most important is the Sadon region where the largest lead deposit in the Caucasus is located. Smaller deposits are the Buronsk, Zgidsk, Kholstinsk, and Arkhonsk.

The Sadon polymetallic ore deposit is located at the notch of the Sadon River and its left tributary, the Kholdon. The deposit occurs amid granite of an ancient age in the form of irregular veins, bisected by a number of faults. The vein appears to consist of separate lenses which, with a few exceptions, do not extend very far horizontally or vertically.

The ore mined in the Sadon deposit is shipped to the dressing plant in Mizur. After selective flotation, two kinds of concentrates are obtained: lead and zinc.

Concentrates from the Mizur dressing plant are shipped to the lead-zinc plant at Ordzhonikidze.

Table 1. Composition of Concentrates Processed at Lead Smelters (%)

Dressing Plant	Lead Smelters	Pb	Zn	Cu	Fe	SiO_2	CaO	Bi	S	Al_2O_3
Tetyukhe (Primorsk)	Tetyukhe (Primorsk)	75.0	3.5	0.5	2.0	1.0	0.3	0.2	15.0	0.4
Leninogorsk (Altay)	Leinogorsk (Altay)	56.0	12.0	4.0	10.0	0.5	1.0	-	20.0	1.5
Zyryanov (Altay)	--	43.0	12.5	9.0	9.0	5.0	-	-	-	-
Achisay (S Kazakhstan)	Chimkent (S Kazakhstan)	44.0	2.0	-	15.5	5.0	5.0	-	1.0	1.0
Mizur (N Caucasus)	Elektrotsink (N Caucasus)	70.0	5.0	0.5	6.0	2.5	1.0	0.15	17.0	1.0

Table 2. Work Indices of Furnace in Tetyukhe Lead Smelter (1936)

Products	Charge: Rich Concentrates (kg)	(%)	Poor Concentrates (kg)	(%)	Analysis (%): Zn	Pb	Ag	Cu
Concentrate	25,360.3	73.1			3.12	78.68	0.21	0.41
			22,236.6	68.0	3.74	75.12	0.0174	0.57
Powder	8,465.0	24.4			2.70	75.33	0.012	Traces
			9,130.4	27.9	2.29	75.12	0.016	"
Limestone	865.5	2.5	1,347.5	4.1	-	-	-	-
Total	34,690.8	100.0	32,714.5	100.0				
Coke	3,326.5	9.6	3,334.?	10.2				
	Results: (kg)	(%)	(kg)	(%)				
Slag	3,583.0	9		14	12.28	39.32	0.052	1.63
"	-		5,288.0	-	11.56	37.95	0.042	2.04
Crude lead	17,840.0	50						
" "			14,962	42	0.4	98.77	0.252	0.16

Table 2. Work Indices of Furnace in Tetyukhe Lead Smelter (1936) (Contd)

Products	Fe	SiO_2	CaO	S	Bi	Al_2O_3	$PbSO_4$	PbO	PbS	ZnO	FeO
Concentrate	1.40	0.84	0.28	14.64	0.17	0.21	-	-	-	-	-
	2.42	1.56	0.42	14.92	0.10	0.49	-	-	-	-	-
Powder	0.12	0.36	0.39	6.22	-	-	58.61	37.80	-	-	-
	0.28	0.16	0.22	6.44	-	-	59.46	36.02	1.21	-	-
Limestone	-	0.34	53.04	-	-	-	-	-	-	-	-
Slag	8.54	7.12	9.37	4.13	0.014	3.90	14.64	13.57	19.33	15.15	10.98
"	8.82	7.66	10.49	3.46	0.003	3.66	13.73	16 70	15:01	14.53	11.3
Crude lead											
" "	0.9	-	-	-	0.238	-	-	-	-	-	-

Table 3. Analysis of Crude Lead (%)

Elements	Leninogorsk, Altay	Ordzhonikidze, N Caucasus	Chimkent, S Kazakhstan	Tetyukhe, Primorsk Furnace	Tetyukhe, Primorsk Mine
Pb	92 — 96	98.5	97 — 98	98 - 75*	96 - 75*
Au	--	--	--	--	--
Ag	--	--	--	--	--
Cu	2.0 - 7.0	0.45	0.9 — 2.4	0.29**	1.75**
Sn	--	0.006	--	--	--
As	Traces	0.02	0.015 - 0.08	--	--
Sb	0.45 - 2.20	0.25	0.10 - 0.20	--	--
Zn	0.24	0.0	--	0.41	0.20
Ni	--	--	--	--	--
Co	--	--	--	--	--
Bi	0.005	0.128	0.002	0.045	0.325
Fe	0.10	0.072	0.02	0.25	0.15
S	--	--	0.1 - 0.15	--	--

* See Table 4
** Table 4 gives these figures for Sn.

Table 4. Composition of Crude Lead in Various Plants (%)

Plants	Pb	Au	Ag	Cu	Sn	As	Sb	Zr	Ni	Co	Bi	Fe	S
Leninogorsk	92 - 96	--	--	2.0 - 7.0	--	Traces	0.45 - 2.80	0.24	--	--	0.005	0.10	--
"Elektrotsink"	98.65	--	--	0.45	0.006	0.02	0.258	0.04	--	--	0.128	0.072	--
Chimkent	97 - 98	--	--	0.9 - 2.4	--	0.015	0.10 - 0.20	--	--	--	0.002	0.02	0.1 - 0.15
Tetyukhe													
Furnace	98.75	--	--		0.29	--	--	0.41	--	--	0.445	0.25	--
Mire	96.75	--	--		1.75	--	--	0.20	--	--	0.325	0.15	--

/From Spravochnik metallurga po tsvetnym metallam (Handbook for Metallurgists on Ferrous Metals), Vol II, literatura po chernoy; tsvetnoy metallurgii, Gosizdat, Moscow, 1947./

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